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| 10/812,777   | 03/30/2004  | Choong-Chin Liew     | 4231/20551               | 5557             |
| 29933  | 7590        | 05/31/2007           | EXAMINER                 |                  |
| PALMER & DODGE, LLP<br>KATHLEEN M. WILLIAMS<br>111 HUNTINGTON AVENUE<br>BOSTON, MA 02199 |             |                      | SWITZER, JULIET CAROLINE |                  |
|  |             |                      | ART UNIT                 | PAPER NUMBER     |
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

# Office Action Summary

Application No.

10/812,777

Applicant(s)

LIEW, CHOONG-CHIN

Examiner

Juliet C. Switzer

Art Unit

1634

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 3/12/07.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 49-57 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 49-57 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date 10/05
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- ☐ Notice of Informal Patent Application
- ☐ Other: \_\_\_\_\_

### DETAILED ACTION

1. Applicant's election without traverse of Group I, further electing the biomarker combination DMN in the reply filed on 3/12/07 is acknowledged.
2. Claims 49-57 are pending and examined in this office action.

#### *Claim Rejections - 35 USC § 112*

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 51-57 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The recitation "unfractionated samples of lysed blood" is unclear in light of the prosecution history in this application and in the parent applications from which this application claims priority. The specification does not define what is meant by an "unfractionated samples of lysed blood." On its face, such a limitation appears to mean that the whole blood sample is not separated into constituent parts, however, interpretation of the claim in light of the specification, pending claims, and applicant's remarks filed with the amendment results in ambiguity with regard to the meaning of this claim limitation.

An example in the specification which discusses lysis prior to quantification includes a centrifugation step after which the "pellet" is further treated. This is a fractionation after lysis but before quantification.

One might interpret detecting in "unfractionated sample of lysed blood" as requiring that the detection occur relative to RNA that was extracted from the entire blood sample without any

Art Unit: 1634

prior separation into parts, which could be accomplished by direct extraction of the whole blood without separating removing the plasma from the blood sample, for example.

Applicant set forth still a different definition for a similar claim limitation in the remarks filed introducing a similar phrase into the claims in the parent application 10/268730. In discussing basis in the specification for the limitation, applicant stated that the limitation refers to “a sample of whole blood which has not been fractionated into cell populations and includes a drop of blood (see remarks dated 4/25/05, at page 5).” This definition for unfractionated sample of whole blood set forth by applicant would, therefore, allow a fractionation of the cellular material prior to RNA extraction (as exemplified in the instant specification in Example 5).

And so it is unclear what the metes and bounds of the phrase “unfractionated sample of lysed blood” actually encompasses in light of the lack of definition of the phrase in the specification and the many, conflicting possible interpretations in light of the specification, pending claims, and remarks by applicant.

### ***Claim Rejections - 35 USC § 112***

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claims 51-57 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant

Art Unit: 1634

art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The limitation “unfractionated samples of lysed blood” appears in claim 51 to be new matter. The amendment which added this limitation did not cite support for the limitation.

Claims 52-57 depend from claim 51. The specification teaches at page 43 treating a sample with lysing buffer, centrifuging the sample, and then processing the pellet with RT-PCR (example 5). Thus, the sample was fractionated prior to quantifying, and the sample is not an unfractionated sample of lysed blood. The examiner was not able to identify basis for this limitation in the specification.

7. Claims 49-57 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

#### **Nature of the invention**

The invention is drawn to a method detecting osteoarthritis in a human test subject. The claims all include a step of determining the level RNA encoded by the gene desmuslin (DMN) in a blood sample obtained from said human and comparing the level with the level of control RNA encoded by said gene in RNA of blood samples from control subjects, and wherein said comparison is indicative of osteoarthritis in said human test subject. Thus, the independent claim, as written, states that a comparison of a human test subject DMN RNA level in a blood sample to a control indicates that osteoarthritis is present in the test subject. The nature of the invention requires the knowledge of a reliable association between comparing DMN expression

Art Unit: 1634

and the indication that osteoarthritis is present in a human. Further, the practice of the invention requires an understanding of how the presence of osteoarthritis effects the level of DMN expression in human blood.

### **Scope of the claims**

The claims are extremely broad because they set forth that any or all comparison between a test subject and RNA level from “control subjects” is indicative of disease. The claims are broad with regard to whether or not the comparison requires identifying a difference in expression or not, and if a difference is detected whether that is an increase in RNA levels or a decrease in RNA levels. The claims are broad with regard to the “control subjects” would could encompass patients with osteoarthritis cancer, healthy patients, patients with some other disease, such as patients with a particular stage of osteoarthritis, patients with osteoarthritis in combination with other conditions, or patients with renal cell carcinoma etc., and set forth that the comparison alone is sufficient to indicate osteoarthritis, no matter the result of the comparison. Even claims 54 and 55, which further define the control subjects do not set forth the direction of the difference necessary to indicate osteoarthritis. The claims are very broad in scope because they encompass that ANY level and direction of difference in gene expression between the tested subjects is indicative of disease. That is, the claims do not set forth that one level should be higher or lower than the other, and further do not set forth how much of a “difference” between two individuals would be necessary to draw the conclusions set forth in the claims.

### **Teachings in the Specification/Examples**

Regarding osteoarthritis, the specification provides example 24 wherein gene expression profiles of blood samples from individuals having osteoarthritis were compared with normal individuals, that is healthy patients. The specification teaches that 300 genes were identified as being differentially expressed, and regarding the instant claims, table 3O provides a list of these genes (Example 24). DMN is among the genes.

The tables list genes that were differentially expressed, but does not provide any further information. For example, the tables do not teach if the expression was higher or lower in osteoarthritis patients versus controls.

The specification does not provide any guidance as to the level of “difference” that is sufficient (1 fold, 2 fold, etc) to result in a conclusion that osteoarthritis is detected, nor does the specification provide any guidance as to the direction of the difference (higher or lower expression) that is expected to be observed for any single pairing of samples. The claims suggest that detecting and comparing expression of DMN alone is sufficient to indicate the presence of osteoarthritis (that is detect osteoarthritis). The plain language of the claims suggests that any comparison between a test subject and control subjects, even as few as two control subjects, is sufficient to conclude that osteoarthritis is detected.

Additionally, DMN is not reported as being differentially expressed when tests are done with patients having osteoarthritis and hypertension as compared with normal patients (Table 3A), or osteoarthritis and obesity as compared with normal patients (Table 3B) or osteoarthritis and allergies as compared with normal patients (Table 3C), or osteoarthritis and subject to systemic steroids compared with normal patients (Table 3D). Furthermore, the gene does not appear in Table 3AB which provides genes that are differentially expressed in blood from

Art Unit: 1634

patients with mild or sever OA but genes relevant to asthma, obesity, hypertension, systemic steroids and allergies have been removed. Thus, the gene is not significantly differentially expressed in all patients with osteoarthritis relative to normal patients.

The specification fails to provide information about an essential aspect of the invention, namely, the nature of the difference in expression that was observed between osteoarthritis patients and healthy patients. Furthermore, though the specification teaches that this gene is differentially expressed in osteoarthritis patients versus healthy patients, the specification teaches this is true for hundreds of genes. There is no guidance or analysis of data in the specification to suggest that this gene in particular is sufficient to conclude that osteoarthritis is present in a sample, as is instantly claimed. This information is essential to understanding and practicing the claimed invention because it is critical to knowing how to interpret a particular comparison result.

#### **State of the Prior Art and Level of Unpredictability**

The expression of genes in example 24 was tested by hybridization of samples to a microarray that contains genetic information for tens of thousands of genes. This technology area is highly unpredictable, and as a result significant guidance is required to practice inventions using this type of data. Lee (Clinical Chemistry, 47:8, 1350-1352 (2001)) teaches that despite the technical accuracy of individual observations on an array, these data “are much more prone to numerous false-positive findings fundamentally because of (a) an extremely large number of observations and (b) a very wide dynamic range of gene expression values obtained from gene chip experiments.” In view of these unpredictable aspects of applying such data, Lee teaches



Art Unit: 1634

that replication is necessary to begin to screen out false positive results. There is no replication in the instant specification.

Observing differences in expression between two populations is a highly unpredictable endeavor. The specification clearly exemplifies this for the case of DMN. The specification teaches differential expression of this gene between populations of patients with osteoarthritis and healthy controls. The art of Twine et al. teach that DMN is differentially expressed in the blood of patients who have renal cell carcinoma versus healthy controls (Table 4, ¶0307, and Example 4). So first, even if one carried out the claimed analysis on a test subject, and if one observed a level of expression, it is highly unpredictable how would one begin to know if that level of expression indicated osteoarthritis, renal cell carcinoma, both, one but not the other, something in between or even some other condition or disorder for which the expression profile has not yet been determined.

Further, DMN it is not listed in the tables for differentially expressed genes in patients who have both osteoarthritis and other diseases or conditions versus normal controls. So, this exemplifies that a particular gene is not always differentially expressed in populations of patients having osteoarthritis versus healthy controls. Observing the differential expression result is population dependent- something about patients with osteoarthritis and other diseases or conditions changes the observation. It is unknown and unpredictable whether this is also true for differential expression observations in other diseases. Furthermore, although DMN was not observed to be differentially expressed in any of the other examples in this specification, it is unknown and unpredictable whether it would be expressed in the blood of patients having other bone related diseases or other types of arthritis or any other diseases which were not tested in the

Art Unit: 1634

instant specification or diseases which were tested in the instant specification but in a different population of test subjects, and whether this expression would be different from levels of expression in healthy controls. A method for detection which relies on a comparison between expression in the blood of a test subject and control subjects requires the knowledge of this information in order to reliably “detect” osteoarthritis in a human test subject, as set forth in the claims. The instant specification has not established that all difference, no matter the magnitude nor the direction, relative to any control subjects or even relative to a healthy control subject is indicative of osteoarthritis, yet the claims are sufficiently broad so as to imply this is the case. It is not known under what circumstances the result observed in the instantly examined control and test populations would be repeatable, as the results have not been validated. But even if one were to obtain the same result, it would be unknown because applicant did not disclose the magnitude of difference in expression between osteoarthritis patients or controls, nor did applicant disclose the direction of variation. All of these inquiries are particularly important in this case since the specification is silent as to which differential expression observations would be sufficient to detect the presence of osteoarthritis.

Further, the claims of the instant application set forth the comparison of the gene expression in a single individual versus as few as two other individuals, and they set forth that a comparing gene expression between the two is “indicative of” osteoarthritis. Neither the specification nor the claims set forth a threshold of difference between an individual’s expression and the control expression of DMN in the blood that would be sufficient to conclude that the difference in gene expression between a test individual and any type control group is “indicative of” any of the recited osteoarthritis. Because the claims encompass any level of altered gene

Art Unit: 1634

expression, it is relevant to point out that the art of Cheung et al (2003) teaches that there is natural variation in gene expression among different individuals. The reference teaches an assessment of natural variation of gene expression in lymphoblastoid cells in humans, and analyzes the variation of expression data among individuals and within individuals (replicates) (p.422, last paragraph; Fig 1). The data indicates that, for example, expression of ACTG2 in 35 individuals varied by a factor of 17; and that in expression of the 40 genes with the highest variance ratios, the highest and lowest values differed by a factor of 2.4 or greater (Fig 3). It is thus unpredictable as to whether or not any level of altered gene expression is indicative of a osteoarthritis or the absence of osteoarthritis cancer.

The unpredictability of correlating gene expression level to any phenotypic quality is taught in the post-filing art of Wu (2001). Wu teaches that gene expression data, such as microarray data, must be interpreted in the context of other biological knowledge, involving various types of 'post genomics' informatics, including gene networks, gene pathways, and gene ontologies (p.53, left col.). The reference indicates that many factors may be influential to the outcome of data analysis, and teaches that expression data can be interpreted in many ways. The conclusions that can be drawn from a given set of data depend heavily on the particular choice of data analysis. Much of the data analysis depends on such low-level considerations as normalization and such basic assumptions as normality (p.63 - Discussion). The art of Newton et al (2001) further teaches the difficulty in applying gene expression results. Newton et al. teaches that a basic statistical problem is determining when the measured differential expression is likely to reflect a real biological shift in gene expression, and replication of data is critical to validation (p.38, third full paragraph). There is no replication of data in the instant specification.

**Quantity of Experimentation**

The instant specification does not provide enabling support for the practice of a single embodiment within the claimed invention. In particular, the specification does not provide adequate guidance to appraise one of ordinary skill in the art as to what levels of DMN gene expression must be observed to successfully conclude that osteoarthritis is present. Further, although the specification teaches there are differences in DMN levels in a osteoarthritis population versus a control patient population, the specification is silent as to the nature of the “difference” in magnitude or direction. Thus, given the lack of teaching in the specification and the highly unpredictable nature of the technology, an extensive amount of work would be required to practice the claimed invention.

In order to practice the claimed invention, one would have to undertake an extensive amount of experimentation in a highly unpredictable technology area. One would begin by trying to reproduce the results observed in the instant specification to determine if there is a relative upregulation or downregulation of DMN in osteoarthritis patients versus healthy control patients, as the specification does not even provide this minimal guidance. Without this knowledge one would not even begin to know how to interpret any results obtained in practicing the claimed methods. For example, consider the comparison of a test result and a control population of healthy individuals. How different from the average level of expression of healthy individuals would the test result have to be to indicate osteoarthritis? Would any difference, up or down regulation be indicative of osteoarthritis? Or could one indicate osteoarthritis and one renal cell carcinoma or some other disease? Is DMN expressed in the blood of individuals with a disease other than renal cell carcinoma and osteoarthritis? Is this expression also diagnostic of

Art Unit: 1634

other degenerative diseases or other diseases of the joints or other disorders entirely unrelated to osteoarthritis? What populations could be tested and expected to provide a reliable result? For example, if a subject has allergies, would the practice of the claimed assay be reliably informative in the event that DMN expression is different or the same as the control subjects? In order to reliably use a method for detecting osteoarthritis, one would first have to answer at least these questions. One would also, however, have to carry out this testing for validation, for it is possible that the result observed in the instant specification is intrinsic to the cohort of patients evaluated in applicant's study. Further, one would have to undertake experimentation to determine difference thresholds required to determine that a patient has or does not have a disease.

As discussed, this art area is highly unpredictable.

### **Conclusion**

The claims include methods which encompass the detection in blood of the expression of DMN in a test subject and comparing this expression to control subjects, wherein the comparison itself "is indicative of osteoarthritis." The identification of gene differential expression/disease indication relationships is a highly unpredictable endeavor, requiring extensive experimentation. The specification provides minimal guidance. In light of the factors discussed, therefore, it is concluded that it would require undue experimentation to practice the claimed invention.

### ***Conclusion***

8. No claim is allowed.
9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Juliet C Switzer whose telephone number is (571) 272-0753. The

Art Unit: 1634

examiner can normally be reached on Monday, Tuesday, or Thursday, from 9:00 AM until 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ram Shukla can be reached by calling (571) 272-0735.

The fax phone numbers for the organization where this application or proceeding is assigned are (571) 273-8300. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (571)272-0507.

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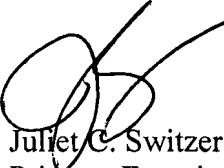
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Application/Control Number: 10/812,777

Page 14

Art Unit: 1634

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A handwritten signature in black ink, consisting of a large, stylized 'J' followed by a cursive 'C' and 'S'.

Juliet C. Switzer  
Primary Examiner  
Art Unit 1634

May 24, 2007